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(54) Title: ENVIRONMENT SIMULATION APPARATUS AND METHOD

(57) Abstract

A method and apparatus for simulating at a second location, at least one feature of an environment at a first location. The apparatus includes a signal generator for generating signals representative of the environment at the first location and an environment simulator at the second location. The signal generator includes at least one measurement device for producing at least one environment signal indicative of a property of the environment, a television camera for producing at least one television signal in response to visual and audio stimuli as observed from the first location, and an inserter for producing a composite signal including the environment signal and the television signal. The environment simulator includes a receiver for receiving the composite signal including the environment signal and the television signal representing the environment, a television data decoder for decomposing the composite signal into the television signal and the environment signal, transducers for producing images and sounds in response to the television signal and, a transducer for controlling at least one feature of the environment in response to the environment signal.

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ENVIRONMENT SIMULATION APPARATUS AND METHOD

BACKGROUND OF THE INVENTION

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This invention relates to an environment simulation apparatus and method and more particularly to a system for recording or transmitting and reproducing at a second location, motion, video and audio sensory information sensed at a first location.

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The ability to experience conditions or an environment situated at a first location in space is achieved by those who are able to physically be present at the first location. Motion pictures and television have enabled experiencing some features of an environment, namely visual and audio features, at a second, remote location from the first location.

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The experience provided by motion pictures and television has been improved by three dimensional cameras and by enhancing audio signal processing, such as evidenced by IMAX(r) and Dolby(r) surround sound.

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The experience of a simulation at a second location of an environment at a first location, has been enhanced by providing motion to an amusement park ride while showing motion pictures and playing sounds. However, this requires specialized equipment and motion picture equipment of a commercial nature, which is impractical for consumer users.

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What would be desirable therefore is the ability to integrate environment signals with television signals depicting the environment, to enable users to purchase add-on equipment for existing television sets to experience motion stimuli, in addition to television pictures and sound. With the advent of new high definition television sets and digital video disk (DVD) technology, a user can experience a reasonable reproduction of sights and sounds

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of a sensed environment, at less cost than with commercial
systems employing motion pictures.

BRIEF SUMMARY OF THE INVENTION

5   In accordance with one aspect of the invention, there is
provided a method of generating signals representative of
an environment. The method includes the steps of:

a)   producing at least one environment signal indicative
10   of a property of the environment;

b)   producing at least one television signal in response
to visual and audio stimuli as observed from a first
location;

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c)   producing a composite signal including the environment
signal and the television signal; and

d)   operating a transducer at the second location in
20   response to the environment signal.

In accordance with another aspect of the invention, there
is provided an apparatus for generating signals
representative of an environment. The apparatus includes
25   at least one measurement device for producing at least one
environment signal indicative of a property of the
environment, a television camera for producing at least one
television signal in response to visual and audio stimuli
as observed from the first location and an inserter for
30   producing a composite signal including the environment
signal and the television signal.

Preferably, the apparatus includes a transmitter for
transmitting the composite signal to a remote location.

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Alternatively, the apparatus may include a recorder for
recording the composite signal.

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Preferably, the apparatus includes a data acquisition system for producing a plurality of movement signals representing movement relative to a plurality of axes, such movement signals including acceleration signals

5   representing acceleration along three mutually orthogonal axes and rotation signals representing rotation about three mutually orthogonal axes.

Preferably, the data acquisition system produces a

10   plurality of codes representing respective features of the environment, including a plurality of codes representing movement relative to respective axes and more particularly acceleration codes representing acceleration of a sensor along at least one axis and rotation codes representing

15   rotation of the sensor about at least one axis.

It is desirable if the data acquisition system produces acceleration codes representing acceleration of the sensor along three mutually orthogonal axes respectively and

20   rotation codes representing rotation of the sensor about the three mutually orthogonal axes respectively.

Preferably, the apparatus includes a data acquisition system for producing vibration codes representing vibration

25   at the first location.

Preferably, the inserter encodes the television signal with the acceleration, rotation and vibration codes in a vertical blanking interval of the television signal.

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Preferably, the apparatus includes a position detection system for generating position data indicative of the geographical position of the first location and preferably, the inserter produces the composite signal such that it

35   includes the position data.

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Preferably, the apparatus includes a data acquisition
system for producing a vibration code representing
vibration at the first location and preferably, the
inserter produces the composite signal such that it
5   includes the vibration code.

In accordance with another aspect of the invention, there
is provided a method of simulating an environment. The
method includes the steps of:

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a)   receiving a composite signal including an
     environment signal and a television signal
     representing the environment;

15   b)   decomposing the composite signal into the television
          signal and the environment signal; and

     c)   producing images and sounds perceptible at a second
          location in response to the television signal; and

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In accordance with another aspect of the invention, there
is provided an apparatus for simulating an environment.
The apparatus includes a receiver for receiving a
composite signal including an environment signal and a
25   television signal representing the environment, a
television data decoder for decomposing the composite
signal into the television signal and the environment
signal, transducers for producing images and sounds
perceptible at a second location in response to the
30   television signal and a transducer at the second location
for controlling at least one feature of the environment in
response to the environment signal.

Preferably, the apparatus includes a processor for
35   extracting position information from the environment signal
and for generating a graphical image in response to the
position information. Preferably the processor combines

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the graphical image with a video portion of the television signal.

Preferably, the apparatus includes a display for displaying
5   images including the graphical image and an image represented by the video portion of the television signal.

Preferably, the apparatus includes a processor for extracting motion data from the environment signal and a
10   support operable to move in response to the motion data.

Preferably, the apparatus includes a processor for extracting vibration data from the environment signal and a vibration transducer actuated in response to the
15   vibration data.

Preferably, the apparatus includes a processor for extracting position information from the environment signal, generating a graphical image in response to the
20   position information, combining the graphical image with a video portion of the television signal, extracting motion data from the environment signal, extracting vibration data from the environment signal, and displaying images including the graphical image and an image represented by
25   the video portion of the television signal while moving a support in response to the motion data and actuating a vibration transducer in response to the vibration data.

In accordance with another aspect of the invention, there
30   is provided a method of simulating at a second location, at least one feature of an environment at a first location. The method includes the steps of:

a)   generating signals representative of the environment
35   at the first location by producing at least one
            environment signal indicative of a property of the
            environment, producing at least one television signal

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in response to visual and audio stimuli as observed
from the first location and producing a composite
signal including the environment signal and the
television signal; and

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b)   at the second location, receiving the composite
signal, decomposing the composite signal into the
television signal and the environment signal,
producing images and sounds in response to the
10   television signal and operating a transducer for
controlling the property of the environment in
response to the environment signal.

In accordance with another aspect of the invention, there
15   is provided an apparatus for simulating at a second
location, at least one feature of an environment at a first
location. The apparatus includes a signal generator for
generating signals representative of the environment at the
first location and an environment simulator at the second
20   location.   The signal generator includes at least one
measurement device for producing at least one environment
signal indicative of a property of the environment, a
television camera for producing at least one television
signal in response to visual and audio stimuli as observed
25   from the first location, and an inserter for producing a
composite signal including the environment signal and the
television signal. The environment simulator includes a
receiver for receiving the composite signal including
environment signal and the television signal representing
30   the environment, a television data decoder for decomposing
the composite signal into the television signal and the
environment signal, transducers for producing images and
sounds in response to the television signal and, a
transducer for controlling at least one feature of the
35   environment in response to the environment signal.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

In drawings which illustrate embodiments of the invention,

Figure 1   is a block diagram of an apparatus for simulating
           at a second location at least one feature of an
           environment at a first location, according to a
           first embodiment of the invention;

Figure 2   is a perspective view of a motion capture
           subsystem, according to the first embodiment
           showing axes about which motion measurements are
           taken;

Figure 3   is a block diagram of a multimedia data encoder,
           according to the first embodiment of the
           invention;

Figure 4   is flowchart of a packet routine run by a
           processor in the multimedia data encoder,
           according to the first embodiment of the
           invention;

Figure 5   is a schematic representation of a data packet
           produced by the multimedia data encoder,
           according to the first embodiment of the
           invention;

Figure 6   is a block diagram of a personal computer
           multimedia system according to the first
           embodiment of the invention;

Figure 7   is a flowchart of a channel data interrupt
           routine run by the personal computer, according
           to the first embodiment of the invention;

Figure 8   is   a   schematic   representation   of   a   motion
            platform according to the first embodiment of the
            invention; and

5   Figure 9   is an apparatus for the simultaneous recording of
            motion, video and audio according to a second
            embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION
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Referring to Figure **1**, an apparatus for simulating at a
second location, a least one feature of an environment at
a first location, according to a first embodiment of the
invention includes an environment signal production system
15   **10** and an environment simulator **12**.

Environment Signal Production System
The environment signal production system **10** includes an
environment data acquisition system **11** and a combiner **13**
20   which cooperate to generate signals representative of an
environment.

Environment Data Acquisition System
The environment data acquisition system **11** includes four
25   subsystems, namely, a motion capture subsystem **18**, an
audio/video capture subsystem **20**, a vibration capture
subsystem **22**,   and a position profile subsystem **24**.   The
environment data acquisition system **11** is a portable remote
system designed to be placed in an existing system (not
30   shown) the environment of which is to be measured and
simulated.   Such environment may be that of a cockpit of an
aircraft, for example.

Motion Capture Subsystem
35   Referring now to Figure **2**, the motion capture subsystem **18**
includes an observer station **26** and a motion sensor **28**.
The observer station **26** is a chair-like structure having a

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seat **30** and a seat back **32** in which an individual observer
in the actual environment being sensed may be seated.
Typically, the dimensions and structure of the observer
station **26** will be determined by the system in which the
5   environment signal production system **10** is placed, such as
a pilot's cockpit or race car seat. In this embodiment the
chair-like structure forms part of the system in which the
environment signal production system **10** is placed, and is
a pilot's seat in an aircraft.

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The motion sensor **28** is affixed to the bottom of the
observer station **26**. In this embodiment the motion sensor
28 is a MotionPak (Trademark) sensor manufactured by the
Systron Donner company of California.

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The motion sensor **28** includes an inertial sensor cluster
with six degrees of freedom, which measures linear
acceleration along three mutually perpendicular axes x, y
and z, and which measures angular rate of rotation about
20   these same axes. The motion sensor is connected to the
bottom of the observer station such that the positive x
axis is defined to lie in a direction parallel to the plane
of the seat **30** and perpendicular to and away from the line
of intersection of the seat **30** and the seat back **32**.
25   Furthermore, the positive x, y and z axes are defined to
constitute a "right-hand" coordinate system such that the
relation between the axes may be represented respectively
by the outstretched thumb, index and middle fingers of the
human right hand.

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Thus, with the positive x axis having been defined as
described above, the positive y axis lies in a direction
perpendicular and in a clockwise direction to the positive
x axis, viewed from above, and parallel to the plane of the
35   seat **30**.   The positive z axis extends in a direction
perpendicular to both the positive x axis and the positive
y axis and extends downwards from the plane of the seat **30**.

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The three positive axes have the directions shown in Figure
2. In accordance with convention, the use of the negative
sense in respect of any or all of these axes is taken to
mean the direction 180 degrees opposite to the direction of
5   the corresponding positive axis.

Acceleration is measured along each axis x, y and z and
angular rate of rotation about each axis is measured in
planes perpendicular to the x, y and z axes. Positive
10   rotation is measured in a clockwise direction in each plane
when viewed from the origin of the three axes along the
corresponding positive axis as shown in Figure 2. In
accordance with convention, the use of the negative sense
in respect of any or all of these rotational vectors is
15   taken to mean the rotational sense opposite to the sense of
the corresponding positive vector.

In response to linear acceleration and angular rate of
rotation measurements, the motion sensor 28 generates
20   analog voltage signals representing linear acceleration and
angular rate of rotation about each of the axes x, y and z
respectively. The amplitude of each signal generated in
response to linear acceleration varies in the range of
between -7.5VDC and +7.5VDC, according to the instantaneous
25   linear acceleration measured along the associated axis, in
linear proportion to a measurable range of linear
accelerations from -2.0g to +2.0g, where g represents the
gravitational force exerted by the earth on an object at
sea level and is equal to 9.81 m/sec/sec. A negative value
30   of acceleration represents an acceleration in a direction
opposite to the positive axis, or along the negative axis.

The amplitude of each signal generated in response to
angular rate of rotation varies in the range of -2.5VDC to
35   +2.5VDC, according to the instantaneous angular rate of
rotation about respective axes x, y and z, in linear
proportion to a measurable range of angular velocities from

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-100 degrees per second to +100 degrees per second. A
negative value of rate of rotation represents angular rate
of rotation in a rotational sense counterclockwise when
viewed from the origin.

5

The sensor has x, y and z linear acceleration outputs 34,
36, and 38 respectively which continuously provide analog
voltage signals corresponding to the instantaneous linear
acceleration measured by the motion sensor 28 along the
10   positive x, y and z axes. The sensor thus acts as a data
acquisition system or means for producing acceleration
signals representing acceleration along three mutually
orthogonal axes. The sensor also has x, y and z rate
outputs 40, 42, and 44 respectively which continuously
15   provide analog voltage signals corresponding to the
instantaneous angular velocity measured by the motion
sensor 28 about the x, y and z axes respectively. The
sensor thus acts as a data acquisition system or means for
producing rotation signals representing rotation about
20   three mutually orthogonal axes.

Referring back to Figure 1, the linear acceleration outputs
34, 36 and 38 and the rate outputs 40, 42 and 44 are shown
generally at 45 and are connected to the combiner 13.
25   Generally, the motion sensor 28 acts as a data acquisition
system or means for producing a plurality of movement
signals representing movement relative to a plurality of
axes. Such movement signals are indicative of properties
of   the   sensed   environment,   the   properties   being
30   acceleration and rotation of the environment in space.
Hence it may be said that the sensor acts as a measurement
device or means for producing at least one environment
signal indicative of a property of the environment.

35   The Audio/Video Capture Subsystem
The audio/video capture subsystem 20 includes a stabilizing
platform 46, a video camera 48 and a microphone 52. The

stabilizing platform **46** is physically positioned in
proximity to the observer station **26** and the video camera
48 is mounted on the stabilizing platform **46**. The
locations of the stabilizing platform **46** and video camera
5   **48** are selected to maximize the quality of the video images
produced by the video camera **48** and to capture as
faithfully as possible images that would be detected by an
individual seated at the observer station **26**. In this
embodiment, the stabilizing platform **46** includes a Glidecam
10 (R) system which dampens the movement to which the video
camera **48** is subjected, to reduce jitter in video signals
produced by the video camera **48**.

The microphone **52** measures audio disturbances in the audio
15 range and is physically positioned in proximity to the
observer station **26** in order to detect audio disturbances
audible at the observer station **26**. The location of the
microphone **52** is selected to maximize the quality of the
audio signals detected by the microphone **52** to represent as
20 faithfully as possible, audio disturbances that would be
detected by an individual seated at the observer station
26. In operation, the microphone **52** converts audio
disturbances into electrical signals which it transmits on
a microphone cable **56** to the video camera **48**.

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The video camera **48** represents visual images seen by an
observer seated at the observer station **26** with
conventional composite video signals according to a known
video format which, in this embodiment, is that specified
30 by the National Television System Committee (NTSC). Such
video signals are transmitted along a video cable **50** to the
combiner **13**. Thus, the video camera acts as a television
camera or means for producing at least one television
signal in response to visual and audio stimuli as observed
35 from the first location.

Vibration Capture Subsystem

The vibration capture subsystem 22 includes a low frequency microphone 54. The low frequency microphone 54 is physically positioned in proximity to the observer station 26 in order to detect low frequency vibrations in a frequency range of 10Hz to 30Hz, as detected by an observer at the observer station 26. The location of the low frequency microphone 54 is selected to maximize the quality of low frequency signals detected by the low frequency microphone 54 and to represent, as faithfully as possible, low frequency disturbances that would be detected by an individual seated at the observer station 26.

In operation, the low frequency microphone 54 converts low frequency audio disturbances into electrical signals which it transmits along a vibration signal line 58 to the combiner 13. The low frequency microphone 54 thus acts as vibration signal producing means for producing signals representing vibration experienced in the environment. As vibration is a property of the environment being sensed, it may be said that the low frequency microphone also acts as a measurement device or means for producing at least one environment signal indicative of a property of the environment, where vibration is the property being sensed.

Position Profile Subsystem

The position profile subsystem 24 includes an antenna 60, and a global positioning system (GPS) processor 62. The antenna 60 receives GPS signals from a satellite network (not shown) established to compile and broadcast such information. In this embodiment the antenna is a Marine IV (Trademark) antenna manufactured by Ashtec Inc. of Sunnyvale, California. The antenna 60 is connected to the GPS processor 62 which decodes the signals received from the satellite network to produce a serial GPS data message in accordance with the National Marine Electrical Association (NMEA) recommendation 0183 at an output 64.

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The output **64** is connected to the combiner **13**. In this embodiment the GPS processor **62** is a G12 GPS board manufactured by Ashtec Inc. of Sunnyvale, California. The antenna **60** and GPS processor **62** thus act as a position

5   detection system or means for generating position data indicative of the geographical position of the first location. In the embodiment shown, the first location is in an aircraft and therefore as the aircraft moves, longitude and latitude positions of the aircraft are

10 represented by said position data.

The signal produced by the GPS system acts as an environment signal indicative of a property of the environment, where such property is the geographical

15 position of the environment in space.

Combiner

The combiner **13** includes a multimedia data encoder **70**, a TV data encoder **72** and a television transmitter **74**.

20

Referring to Figure **3**, the multimedia data encoder is shown generally at **70** and includes a scaling and offset circuit **76**, a multiplexer (MUX) **78**, an analog to digital converter **80**, an I/O circuit **82**, a microprocessor **84**, an RS-232-C

25 interface circuit **86**, random access memory (RAM) **88** and read only memory (ROM) **90**.

The scaling and offset circuit **76** has a plurality of inputs A, B, C, D, E, F, G for receiving the signals representing

30 instantaneous linear acceleration and instantaneous angular velocity provided by the linear acceleration outputs and the rate outputs, and for receiving the vibration signal from the low frequency microphone **54**. Essentially, the scaling and offset circuit scales the signals received at

35 the inputs to **0**-5 volts. The scaling and offset circuit thus has a plurality of outputs **92** which provide scaled and offset signals representing scaled versions of the motion

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signals   and   the   low   frequency   microphone   signal
respectively.

The multiplexer has a plurality of inputs 94 which are
5   connected to the outputs 92 of the scaling and offset
circuit to receive the scaled and offset signals.   The
multiplexer also has a control input 96 which is connected
to an output 99 of the I/O circuit 82 for receiving signals
for directing the MUX to select an input 94.   The MUX
10   further has an output 98 which is connected to the analog
to digital converter 80.   The I/O circuit has an output 100
which is connected to the analog to digital converter 80 to
control the analog to digital converter 80 and further has
an input 102 for receiving 16 bit digital signals produced
15   by the analog to digital converter 80.

The I/O circuit further includes a universal asynchronous
receiver/transmitter 104 which is connected to the RS-232-C
interface 86.   The I/O circuit 82 also has a 16 bit data
20   bus output 106 for communication with the microprocessor
84.

The ROM 90 is programmed with codes which direct the
microprocessor 84 to execute a packet routine 108.   The
25   packet routine establishes buffers within the RAM 88,
including a header buffer 110, a length buffer 112, an
accelerationX buffer 114, an accelerationY buffer 116, an
accelerationZ buffer 118, a rateX buffer 120, a rateY
buffer 122, a rateZ buffer 124, a low frequency buffer 126,
30   and a checksum buffer 128.   Each of these buffers has a 2
byte length.

Referring to Figures 3 and 4, the packet routine is shown
generally at 108 and includes a first block of codes 130
35   which direct the microprocessor 84 to select a channel A,
B, C, D, E, F, G, by writing to the I/O circuit 82 to

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control the output **99** to cause the multiplexer **78** to direct
signals from one of the inputs **94** to its output **98**.

5   After selecting a channel, block **132** directs the
microprocessor **84** to write to the I/O circuit **82** to cause
the output **100** to produce a signal to direct the analog to
digital converter **80** to begin conversion and to present, at
the input **102** of the I/O port, a **16** bit digital value
representing the instantaneous value of the signal
10 appearing at the selected input **94**. When channels A, B or
C are selected the acceleration signals are applied to the
A/D converter, which produces acceleration codes
representing acceleration of the sensor **28** along the three
mutually orthogonal axes respectively. The A/D converter
15 thus acts as a data acquisition system or means for
producing acceleration codes representing acceleration of
the sensor along three mutually orthogonal axes
respectively.

20 Similarly, when channels D, E or F are selected, the
rotation signals are applied to the A/D converter, which
produces rotation codes representing rotation of the sensor
28 about the three mutually orthogonal axes respectively.
The A/D converter thus further acts as a data acquisition
25 system or means for producing rotation codes representing
rotation of the sensor about the three mutually orthogonal
axes respectively. The acceleration codes and rotation
codes may be generally referred to as movement codes. The
A/D converter thus acts as a data acquisition system or
30 means for producing a plurality of codes representing
movement relative to respective axes.

Similarly, when channel G is selected, the vibration signal
is applied to the A/D converter which produces vibration
35 codes representing vibration of the observer's station at
the first location. The A/D converter thus further acts as
a data acquisition system or means for producing a

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vibration code representing vibration at the first location.

In general, it may be said that by the production of the
5   acceleration, rotation and vibration codes, the A/D converter acts as a data acquisition system or means for producing a plurality of codes representing respective features of the environment.

10   Still referring to Figures 3 and 4, block 134 then directs the microprocessor 84 to read the I/O circuit output 106 to obtain the code or digital value produced by the analog to digital converter 80 and block 136 directs the microprocessor 84 to store the code so obtained in the
15   appropriate buffer 114-126 corresponding to the input 94 selected at block 130.

Block 138 then directs the microprocessor 84 to repeat the above process for each input 94 until signals from each
20   channel A-G have been read and corresponding codes have been stored in corresponding buffers 114-126 in the RAM 88.

Block 140 then directs the microprocessor 84 to store a header in the header buffer 110, the header being a
25   predefined value used to identify that a data packet to be produced by the system relates to that of motion data.

Block 142 then directs the microprocessor 84 to scan the contents of the buffers 110-126 to calculate and store in
30   the length buffer 112, a number indicating the total number of bytes stored in buffers 110-126.

Block 144 then directs the microprocessor 84 to use the contents of buffers 110-126 to calculate a checksum value,
35   as is common in the art, and to store such checksum value in the checksum buffer 128.

Block **146** then directs the microprocessor **84** to write to
the I/O circuit **82** and specifically to the UART **104**, the
contents of the buffers **110-128**.

5   Essentially, the UART **104** produces an environment signal
which is a serial bitstream including a data packet as
shown generally at **150** in Figure **5** including a header field
152, a length field **154**, an accelerationX field **156**, an
accelerationY field **158**, an accelerationZ field **160**, a
10 rateX field **162**, a rateY field **164**, a rateZ field **166**, a
vibration field **168** and a checksum field **170**. Block **146** of
the packet routine directs the microprocessor **84** to control
the UART **104** such that the contents of fields **152** through
170 contain the contents of the buffers **110-128**
15 respectively.

It is desirable that the baud rate of the data packet **152**
so produced is as high as possible, however, in this
particular embodiment, a limitation of approximately
20 **115.2**kbps is imposed, due to limitations of other
equipment.

Effectively, the multimedia data encoder **70** receives analog
signals from the motion sensor and from the low frequency
25 microphone and produces an environment signal which is a
serial bitstream in compliance with the RS-232-C
specification, having a protocol including fields for
carrying payload data representing the instantaneous values
of linear acceleration, rotation and vibration experienced
30 by the observer in the sensed environment. The environment
data acquisition system **11** thus produces an environment
signal, i.e. the serial bitstream, indicative of a
plurality of properties of the environment. In this
embodiment the properties include linear acceleration,
35 rotation and vibration.

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TV Data Encoder

Referring back to Figure 1, in this embodiment the TV data
encoder 72 includes a TES5 digital inserter manufactured by
the Norpak Corporation of Kanata, Ontario. This device is
a highly flexible digital video platform which carries out
encoding, insertion, reception, bridging and multiplexing
of data in the vertical blanking interval (VBI) and active
video of any component serial digital television signal.
The Norpak unit has a plurality of inputs and has a single
output, only some of the inputs being used in this
embodiment. The inputs used include a serial digital
program video input 172 for receiving the serial digital
program video composite signal produced by the camera 48.
The inputs used in this embodiment further include a serial
port A input 174 and a serial port B input 176. The TV
data encoder further includes a serial digital program
video output 178. The serial port A input 174 is connected
to the serial port output 87 of the multimedia data encoder
and is therefore operable to receive the data packet 150
representing motion and low frequency information from the
data encoder 70.

The serial port B input 176 is connected to the output 64
of the GPS processor 62 and is thereby operable to receive
GPS position data messages from the GPS receiver, in a
serial data format.

The output 178 of the inserter produces a conventional
composite video signal in which data received at serial
ports A and B, 174 and 176 respectively are encoded on any
combination of lines 10 to 25 (7 to 22 in 625 line systems)
in any video format including NTSC, PAL, SECAM, 525 and 625
line. Data can be encoded and transmitted in this portion
of the composite television signal, at data rates up to
115.2 kbps. The Norpak unit provides built-in forward
error correction.

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The TV data encoder **72** thus has an output **178** which
provides a composite video signal on which motion and low
frequency data and GPS data is encoded on a portion of the
video signal.   The TV data encoder **72** thus acts as an
5   inserter, or means for producing a composite signal
including the environment signal and the television signal.

In this embodiment, there are two environment signals, one
from the data encoder **70** and one from the GPS processor **62**.
10   Hence, the inserter encodes the television signal produced
by the camera **48** with the acceleration, rotation and
vibration codes and with the position data.   Hence the
composite video signal produced by the TV data encoder **72**
includes the acceleration, rotation and vibration codes and
15   position data.   The TV data inserter thus acts as means for
encoding the acceleration, rotation and vibration codes in
a vertical blanking interval of the television signal and
as means for producing the composite video signal such that
it includes the position data and as means for producing
20   the composite video signal such that it includes the
vibration code.

The composite video signal is received at an input **180** of
the television transmitter **74**.   In this embodiment, the
25   television transmitter **74** is conventional and transmits the
composite video signal, including encoded motion and low
frequency data, and GPS data for reception by remotely
located television receivers, using conventional radio
waves or using cable systems.   The television transmitter
30   thus acts as means for transmitting the composite signal to
a remote location.

In general, it will be appreciated that the environment
signal production system acts as a signal generator or
35   means for generating signals representative of the
environment.

Environment Simulator

Referring back to Figure 1, the environment simulator is
shown generally at 12. The environment simulator includes
a TV receiver 182, a PC multimedia system 184, a display
5   186, a loudspeaker 188, a motion platform shown generally
at 190, and a vibrator shown generally at 192. The
environment simulator is at a second location, remote from
the first location, such as an amusement park.

10   The TV receiver 182 receives radio frequency signals
containing the composite video signal including encoded
motion and low frequency data, from the TV transmitter 74.
The TV receiver demodulates the radio frequency signals to
provide a baseband composite video signal at an output 194
15   thereof. The TV receiver thus acts as means for receiving
a composite signal including an environment signal and a
television signal representing the environment.

Referring to Figure 6, the PC multimedia system is shown
20   generally at 184 and includes a personal computer having a
high speed microprocessor 196, temporary memory 198, a
permanent memory 199 and a personal computer bus 200.
Connected to the personal computer bus are a TV data
decoder card 202, a video display adapter card 204, an
25   audio card 206 and a serial interface card 208.

In this embodiment, the microprocessor 196 is an Intel
Pentium (R) 300 MHz processor.

30   In this embodiment, the TV data decoder card 202 is a
Norpak TTX71X PC bus card receiver which interfaces
directly with the PC bus 200. The TV data decoder card 202
has a composite video input 210, a composite video output
212 and a PC bus interface 214. The composite video input
35   210 is connected to receive the base band composite video
signal, complete with environmental data from the output
194 of the TV receiver 182 shown in Figure 1.

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Referring back to Figure 6, the TV data decoder card **202** extracts the environmental data encoded on the vertical blanking interval of the composite video signal and provides a pure composite video signal without
5   environmental data, at the composite video output **212**. Environmental data extracted from the VBI interval of the composite video signal received at the input **210** is presented to the PC bus in such a manner that the microprocessor **196** is interrupted when a data packet is
10   available. Effectively, the PC bus interface **214** provides to the microprocessor **196**, data decoded from the composite video signal and an interrupt vector indicating the channel A or B on which the data was received. Thus, the TV data decoder acts as means for decomposing the composite signal
15   into the television signal and the environment signal.

The video display adapter card **204** is, in this embodiment, an ATI-TV ISA bus card manufactured by ATI of California. This bus card has a PC bus interface **216**, a video input
20   **218**, a video port output **220** and an audio output **222**. The composite video output **212** of the TV data decoder card **202** is connected to the video input **218** of the video display adapter card **204** to receive the composite video signal. The video display adapter card has video buffer memory (not
25   shown) for digitizing video signals received at the video input **218** and has display memory (not shown) for storing digitized video signals for driving the display **186** shown in Figure 1 through the video port **220**. In addition the video display adapter card includes an audio decoder (not
30   shown) which decodes audio from the composite video signal appearing at the video input **218** and presents pure audio signals at the audio output **222** for amplification by an audio amplifier (not shown) to drive the loudspeaker **188** shown in Figure 1. The video display adapter card,
35   display, audio amplifier and loudspeaker thus act as means for producing images and sounds perceptible at a second location in response to the television signal.

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Referring back to Figure 6, the video display adapter card **204** further includes a processor (not shown) for transferring the contents of the video buffer memory (not shown) to the video display memory (not shown) and for

5   receiving data from the PC bus interface **216** as provided by the microprocessor **196**, and for writing such data into the video display buffer, along with the contents of the video input buffer, to cause graphical images to overlay video images represented by the pure composite video signal

10   appearing at the video input **218**. The video display adapter **204** also has control registers (not shown), which are loaded by the microprocessor **196** through the PC bus interface **216**, to allow the microprocessor **196** to control positioning and sizing of video and graphical images

15   represented by the contents of the video display buffer.

The audio card **206** is a standard audio card having a PC bus interface **224** and an audio output **226**. The effective component in the audio card is a digital to analog

20   converter (not shown), which receives input data from the microprocessor **196**, through the PC bus interface **224** and provides analog signals in response thereto, at the audio output **226**. The audio output **226** is connected to an audio amplifier (not shown) for driving the vibrator **192** shown in

25   Figure 1.

Referring back to Figure 6, the serial interface card **208** is a standard serial interface found on any personal computer and has a bus interface **228** for receiving data

30   from the microprocessor **196** and has an output **230** for representing such data in an RS-232-C format. The output **230** is connected to the motion platform shown generally at **190** in Figure 1.

35   Referring back to Figure 6, the permanent memory **199** includes codes readable by the microprocessor **196**, for

directing the processor to execute a channel data interrupt
routine **232**.

The channel data interrupt routine **232** directs the
5   microprocessor **196** to establish in the temporary memory
198, a full packet buffer **236**, a motion packet buffer **238**,
a vibration buffer **240**, a GPS data receive buffer **242** and
a graphics data buffer **244**.

10   Referring to Figures 6 and 7, the channel data interrupt
routine is shown generally at **232** and begins upon receipt
of a channel data interrupt from the TV data decoder card
202 at the PC bus **200**. Upon receiving the channel data
interrupt at the microprocessor **196**, block **246** directs the
15   microprocessor to read an interrupt vector provided by the
TV data decoder PC bus interface **214** to determine whether
or not the instant data packet is associated with channel
A or B. If associated with channel A, the data packet
relates to motion data and vibration data and block **248**
20   directs the microprocessor to store the packet in the full
packet buffer **236**. The full packet buffer has a plurality
of two byte fields for storing the contents of respective
fields **152** through **170** of the data packet **150** shown in
Figure 5.
25
Referring back to Figures 6 and 7, block **250** directs the
microprocessor **196** to load the motion packet buffer **238**
with the contents of the full packet buffer **236**, with the
exception of the contents of the very low frequency field
30   and the checksum field. The microprocessor thus acts as
means for extracting motion data from the environment
signal.

Block **252** then directs the microprocessor **196** to transmit
35   the contents of the motion packet buffer **238** to the serial
interface card **208**, which provides a motion data serial
bitstream similar to that shown in Figure 5, without the

vibration field **168** and the checksum field **170**, to the
motion platform **190** shown in Figure 1.

Referring back to Figures 6 and 7, block **254** then directs
5   the microprocessor **196** to retrieve the contents of the
vibration field **168** from the full packet buffer **236** and
store such contents in the vibration buffer **240**.   The
microprocessor thus acts as means for extracting vibration
data from the environment signal.
10

Block **256** then directs the microprocessor **196** to write the
contents of the vibration buffer **240** to the audio card **206**,
which produces an analog signal at its output **226**, for
presentation to an amplifier and to the vibrator **192** shown
15   in Figure 1.   The audio card **206** thus acts as means for
actuating a vibration transducer in response to the
vibration data.   More generally, the audio card acts as
means for operating a transducer at the second location, in
response to the environment signal.
20

Referring back to Figures 6 and 7, in the event that upon
receiving the channel data interrupt, the TV data decoder
card **202** provides an interrupt vector indicating that the
instant data is associated with that of channel B, the
25   microprocessor is directed to block **258** which directs it to
store the instant data packet in the GPS data buffer **242**.
The microprocessor thus acts as means for extracting
position information from the environment signal.

30   Block **260** then directs the microprocessor **196** to translate
the contents of each field in the GPS data packet into a
corresponding graphical component, and to store such
graphical component in graphics fields within the graphics
data buffer **244**.   The microprocessor thus acts as means for
35   generating a graphical image in response to the position
information.

Block **262** then directs the microprocessor to write the
contents of the graphics data buffer **244** to the video
display adapter card **204**. The processor (not shown) in the
video display adapter, in response, sets the contents of

5   the video display memory accordingly, such that graphical
images representing the GPS data will appear on the display
186 shown in Figure **1**. The video display adapter card thus
acts as means for combining the graphical image with a
video portion of the television signal and the display acts

10 as means for displaying images including the graphical
image and an image represented by the video portion of the
television signal.

In effect, when a data packet from either channel A or

15 channel B is received, the contents of respective fields
within the corresponding data packet are parsed and
transmitted to a corresponding device on the PC bus.

Referring to Figure **8**, the motion platform is shown

20 generally at **190** and includes a six-degree-of-freedom
motion platform which, in this embodiment, is provided by
Servos and Simulation Inc. of Maitland, Florida, U.S.A.
The motion platform includes a VME computer **270** and a six-
degree-of-freedom unit shown generally at **272**. The VME

25 computer **270** has an input **288** which is connected to the
output **230** of the serial interface card **208** to receive the
serial bitstream representing the motion data protocol from
the serial interface card. The VME computer **270**
communicates with an interface unit **273** of the six-degree-

30 of-freedom unit **272**, using an advanced Ethernet **100** base T
connection **286**, and the TCP/IP protocol.

The six-degree-of-freedom unit **272** has a base **274** to which
is mounted a plurality of extendable actuators, one of

35 which is shown at **276**. Each of the actuators has a distal
end portion connected to a platform **278**, on which is
mounted a seat shown generally at **280** having a generally

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horizontal portion **282** and a generally vertical portion **284**.

In this embodiment, the VME computer **270** and the six-
degree-of-freedom unit **272** are sold as a single system as
model number **710-6-X-115**. Software operable to run on the
VME computer **270**, specific to the present embodiment, is
sold under the serial number **710-6-X-55ASW**. Effectively,
the hardware and software cooperate to move the seat **280** in
response to the contents of respective data fields within
the motion data bitstream received from the serial
interface card **208** shown in Figure 8. The software run by
the VME computer includes transfer functions (not shown),
for translating the data contained in each field of the
motion data protocol into an associated range of extension
of one or more actuators of the six-degree-of-freedom unit
272, to cause the seat **280** to move in such a manner that a
person sitting in the seat **280** experiences generally the
same feeling of movement experienced by a person sitting in
the seat **30** shown in Figure **1**, from which the signals were
derived. The motion system thus acts as means for moving
a support in response to the motion data.

Referring back to Figure 1, the motion platform **190** is
positioned relative to the display **186**, the loudspeaker **188**
and the vibrator **192** such that a person sitting in the seat
280 may observe the display **186**, hear sounds produced by
the loudspeaker **188** and experience vibrations produced by
the vibrator **192**, in such a manner that visual, audio,
vibratory and motional effects experienced by a person
sitting in seat **30** shown in Figure **1** are similarly
experienced by a person sitting on the seat **280**. In other
words, the PC multimedia system **184**, display **186**, motion
platform **190** and vibrator **192** cooperate to act as means for
displaying images including the graphical image and an
image represented by the video portion of the television
signal while moving a support in response to the motion

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data and actuating a vibration transducer in response to
the vibration data.

Alternatives

5 Referring to Figure **9**, in an alternative embodiment, the TV
transmitter (**74** in Figure **1**) and the TV receiver (**182** in
Figure **1**) are replaced with a composite television signal
recorder **374** and a composite television signal playback
unit **382** respectively. This allows the composite signal
10 representing the environment to be recorded and played back
at a later date or time.   It also facilitates transfer of
the composite signal to editing equipment (not shown) which
may be used to edit, alter or add to the video, sound
motion data or position data as desired.   The recorder **374**
15 thus acts as means for recording said composite signal.

While specific embodiments of the invention have been
described and illustrated, such embodiments should be
considered illustrative of the invention only and not as
20 limiting the invention as construed in accordance with the
accompanying claims.

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What is claimed is:

1. A method of generating signals representative of an
    environment, the method comprising the steps of:

    a)   producing   at   least   one   environment   signal
         indicative of a property of said environment;

    b)   producing at least one television signal in
         response to visual and audio stimuli as observed
         from a first location; and

    c)   producing a composite signal including said
         environment signal and said television signal.

2. A method as claimed in claim 1 further including the
    step of transmitting said composite signal to a remote
    location.

3. A method as claimed in claim 1 further including the
    step of recording said composite signal.

4. A method as claimed in claim 1 further including the
    step of producing a plurality of movement signals
    representing movement relative to a plurality of axes.

5. A method as claimed in claim 4 further including the
    step of producing acceleration signals representing
    acceleration along respective axes.

6. A method as claimed in claim 5 further including the
    step of producing acceleration signals representing
    acceleration along three mutually orthogonal axes.

7. A method as claimed in claim 4 further including the
    step of producing rotation signals representing
    rotation about respective axes.

8.   A method as claimed in claim 7 further including the
     step of producing rotation signals representing
     rotation about three mutually orthogonal axes.

9.   A method as claimed in claim 1 further including the
     step of producing a plurality of codes representing
     respective features of said environment.

10. A method as claimed in claim 9 further including the
     step of producing a plurality of codes representing
     movement relative to respective axes.

11. A method as claimed in claim 10 further including the
     step of producing acceleration codes representing
     acceleration of a sensor along at least one axis.

12. A method as claimed in claim 11 further including the
     step of producing rotation codes representing rotation
     of said sensor about at least one axis.

13. A method as claimed in claim 10 further including the
     steps of:

     a)   producing acceleration codes representing
          acceleration of a sensor along three mutually
          orthogonal axes respectively; and

     b)   producing rotation codes representing rotation of
          said sensor about said three mutually orthogonal
          axes respectively.

14. A method as claimed in claim 13 further including the
     step of producing vibration codes representing
     vibration at said first location.

15. A method as claimed in claim **14** further including the step of encoding said television signal with said acceleration, rotation and vibration codes.

16. A method as claimed in claim **15** further including the step of encoding said acceleration, rotation and vibration codes in a vertical blanking interval of said television signal.

17. A method as claimed in claim **1** further including the step of generating position data indicative of the geographical position of said first location and producing said composite signal such that it includes said position data.

18. A method as claimed in claim **17** further including the step of producing a vibration code representing vibration at said first location and producing said composite signal such that it includes said vibration code.

19. An apparatus for generating signals representative of an environment, the apparatus comprising:

    a)   at least one measurement device for producing at least one environment signal indicative of a property of said environment;

    b)   a television camera for producing at least one television signal in response to visual and audio stimuli as observed from a first location; and

    c)   an inserter for producing a composite signal including said environment signal and said television signal.

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20. An apparatus as claimed in claim 19 further including
    a transmitter for transmitting said composite signal
    to a remote location.

21. An apparatus as claimed in claim 19 further including
    a recorder for recording said composite signal.

22. An apparatus as claimed in claim 19 further including
    a data acquisition system for producing a plurality of
    movement signals representing movement relative to a
    plurality of axes.

23. An apparatus as claimed in claim 22 wherein said data
    acquisition system produces acceleration signals
    representing acceleration along respective axes.

24. An apparatus as claimed in claim 23 wherein said data
    acquisition system produces acceleration signals
    representing acceleration along three mutually
    orthogonal axes.

25. An apparatus as claimed in claim 22 wherein said data
    acquisition system produces rotation signals
    representing rotation about respective axes.

26. An apparatus as claimed in claim 25 wherein said data
    acquisition system produces rotation signals
    representing rotation about three mutually orthogonal
    axes.

27. An apparatus as claimed in claim 22 wherein said data
    acquisition system produces a plurality of codes
    representing respective features of said environment.

28. An apparatus as claimed in claim 27 wherein said data
    acquisition system produces a plurality of codes
    representing movement relative to respective axes.

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29. An apparatus as claimed in claim 28 wherein said data
    acquisition   system   produces   acceleration   codes
    representing acceleration of a sensor along at least
    one axis.

30. An apparatus as claimed in claim 29 wherein said data
    acquisition   system   produces   rotation   codes
    representing rotation of said sensor about at least
    one axis.

31. An apparatus as claimed in claim 28 wherein said data
    acquisition   system   produces   acceleration   codes
    representing acceleration of a sensor along three
    mutually orthogonal axes respectively and rotation
    codes representing rotation of said sensor about said
    three mutually orthogonal axes respectively.

32. An apparatus as claimed in claim 31 wherein said data
    acquisition   system   producing   vibration   codes
    representing vibration at said first location.

33. An apparatus as claimed in claim 32 wherein said
    inserter encodes said television signal with said
    acceleration, rotation and vibration codes.

34. An apparatus as claimed in claim 33 wherein said
    inserter encodes said television signal with said
    acceleration, rotation and vibration codes in a
    vertical blanking interval of said television signal.

35. An apparatus as claimed in claim 19 further including
    a position detection system for generating position
    data indicative of the geographical position of said
    first location and wherein said inserter produces said
    composite signal such that it includes said position
    data.

36. An apparatus as claimed in claim 35 further including
a data acquisition system for producing a vibration
code representing vibration at said first location and
wherein said inserter produces said composite signal
such that it includes said vibration code.

37. An apparatus for generating signals representative of
an environment, the apparatus comprising:

   a) means for producing at least one environment
      signal indicative of a property of said
      environment;

   b) means for producing at least one television
      signal in response to visual and audio stimuli as
      observed from a first location; and

   c) means for producing a composite signal including
      said environment signal and said television
      signal.

38. An apparatus as claimed in claim 37 further including
means for transmitting said composite signal to a
remote location.

39. An apparatus as claimed in claim 37 further including
means for recording said composite signal.

40. An apparatus as claimed in claim 37 further including
means for producing a plurality of movement signals
representing movement relative to a plurality of axes.

41. An apparatus as claimed in claim 40 further including
means for producing acceleration signals representing
acceleration along respective axes.

42. An apparatus as claimed in claim 41 further including means for producing acceleration signals representing acceleration along three mutually orthogonal axes.

43. An apparatus as claimed in claim 40 further including means for producing rotation signals representing rotation about respective axes.

44. An apparatus as claimed in claim 43 further including means for producing rotation signals representing rotation about three mutually orthogonal axes.

45. An apparatus as claimed in claim 37 further including means for producing a plurality of codes representing respective features of said environment.

46. An apparatus as claimed in claim 45 further including means for producing a plurality of codes representing movement relative to respective axes.

47. An apparatus as claimed in claim 46 further including means for producing acceleration codes representing acceleration of a sensor along at least one axis.

48. An apparatus as claimed in claim 47 further including means for producing rotation codes representing rotation of said sensor about at least one axis.

49. An apparatus as claimed in claim 46 further including:

    a) means for producing acceleration codes representing acceleration of a sensor along three mutually orthogonal axes respectively; and

    b) means for producing rotation codes representing rotation of said sensor about said three mutually orthogonal axes respectively.

50. An apparatus as claimed in claim **49** further including
     means for producing vibration codes representing
     vibration at said first location.

51. An apparatus as claimed in claim **50** further including
     means for encoding said television signal with said
     acceleration, rotation and vibration codes.

52. An apparatus as claimed in claim **51** further including
     means for encoding said acceleration, rotation and
     vibration codes in a vertical blanking interval of
     said television signal.

53. An apparatus as claimed in claim **37** further including
     means for generating position data indicative of the
     geographical position of said first location and
     producing said composite signal such that it includes
     said position data.

54. An apparatus as claimed in claim **53** further including
     means for producing a vibration code representing
     vibration at said first location and producing said
     composite signal such that it includes said vibration
     code.

55. A method of simulating an environment, the method
     comprising the steps of:

     a)   receiving a composite signal including an
          environment signal and a television signal
          representing said environment;

     b)   decomposing said composite signal into said
          television signal and said environment signal;

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    c)   producing images and sounds perceptible at a second location in response to said television signal; and

    d)   operating a transducer at said second location in response to said environment signal.

56. A method as claimed in claim 55 further including the step of extracting position information from said environment signal.

57. A method as claimed in claim 56 further including the step of generating a graphical image in response to said position information.

58. A method as claimed in claim 57 further including the step of combining said graphical image with a video portion of said television signal.

59. A method as claimed in claim 58 further including the step of displaying images including said graphical image and an image represented by said video portion of said television signal.

60. A method as claimed in claim 55 further including the step of extracting motion data from said environment signal and moving a support in response to said motion data.

61. A method as claimed in claim 55 further including the step of extracting vibration data from said environment signal and actuating a vibration transducer in response to said vibration data.

62. A method as claimed in claim 55 further including the steps of:

a) extracting   position   information   from   said
    environment signal;

b) generating a graphical image in response to said
    position information;

c) combining said graphical image with a video
    portion of said television signal;

d) extracting motion data from said environment
    signal;

e) extracting vibration data from said environment
    signal; and

f) displaying images including said graphical image
    and an image represented by said video portion of
    said television signal while moving a support in
    response to said motion data and actuating a
    vibration transducer in response to said
    vibration data.

63. An apparatus for simulating an environment, the
     apparatus comprising:

a) a receiver for receiving a composite signal
    including an environment signal and a television
    signal representing said environment;

b) a television data decoder for decomposing said
    composite signal into said television signal and
    said environment signal;

c) transducers for producing images and sounds
    perceptible at a second location in response to
    said television signal; and

    d)   a transducer at said second location for controlling at least one feature of said environment in response to said environment signal.

64. An apparatus as claimed in claim 63 further including a processor for extracting position information from said environment signal.

65. An apparatus as claimed in claim 64 wherein said processor is programmed to generate a graphical image in response to said position information.

66. An apparatus as claimed in claim 65 wherein said processor is programmed to combine said graphical image with a video portion of said television signal.

67. An apparatus as claimed in claim 66 further including a display for displaying images including said graphical image and an image represented by said video portion of said television signal.

68. An apparatus as claimed in claim 63 further including:

    a)   a processor for extracting motion data from said environment signal; and

    b)   a support operable to move in response to said motion data.

69. An apparatus as claimed in claim 63 further including a processor for extracting vibration data from said environment signal and a vibration transducer actuated in response to said vibration data.

70. An apparatus as claimed in claim 63 further including a processor for:

a)   extracting   position   information   from   said
     environment signal;

b)   generating a graphical image in response to said
     position information;

c)   combining said graphical image with a video
     portion of said television signal;

d)   extracting motion data from said environment
     signal;

e)   extracting vibration data from said environment
     signal; and

f)   displaying images including said graphical image
     and an image represented by said video portion of
     said television signal while moving a support in
     response to said motion data and actuating a
     vibration transducer in response to said
     vibration data.

71. An apparatus for simulating an environment, the
     apparatus comprising:

a)   means for receiving a composite signal including
     an environment signal and a television signal
     representing said environment;

b)   means for decomposing said composite signal into
     said television signal and said environment
     signal;

c)   means for producing images and sounds perceptible
     at a second location in response to said
     television signal; and

d)   means for operating a transducer at said second
location in response to said environment signal.

72.   An apparatus as claimed in claim 71 further including
means for extracting position information from said
environment signal.

73.   An apparatus as claimed in claim 72 further including
means for generating a graphical image in response to
said position information.

74.   An apparatus as claimed in claim 73 further including
means for combining said graphical image with a video
portion of said television signal.

75.   An apparatus as claimed in claim 74 further including
means for displaying images including said graphical
image and an image represented by said video portion
of said television signal.

76.   An apparatus as claimed in claim 71 further including
means   for   extracting   motion   data   from   said
environment signal and moving a support in response to
said motion data.

77.   An apparatus as claimed in claim 71 further including
means   for   extracting   vibration   data   from   said
environment   signal   and   actuating   a   vibration
transducer in response to said vibration data.

78.   An apparatus as claimed in claim 71 further including:

a)   means for extracting position information from
said environment signal;

b)   means   for   generating   a   graphical   image   in
response to said position information;

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    c)   means for combining said graphical image with a video portion of said television signal;

    d)   means for extracting motion data from said environment signal;

    e)   means for extracting vibration data from said environment signal; and

    f)   means for displaying images including said graphical image and an image represented by said video portion of said television signal while moving a support in response to said motion data and actuating a vibration transducer in response to said vibration data.

79. A method of simulating at a second location, at least one feature of an environment at a first location, the method comprising the steps of:

    a)   generating signals representative of said environment at said first location by:

        i)   producing at least one environment signal indicative of a property of said environment;

        ii)   producing at least one television signal in response to visual and audio stimuli as observed from said first location; and

        iii) producing a composite signal including said environment signal and said television signal; and
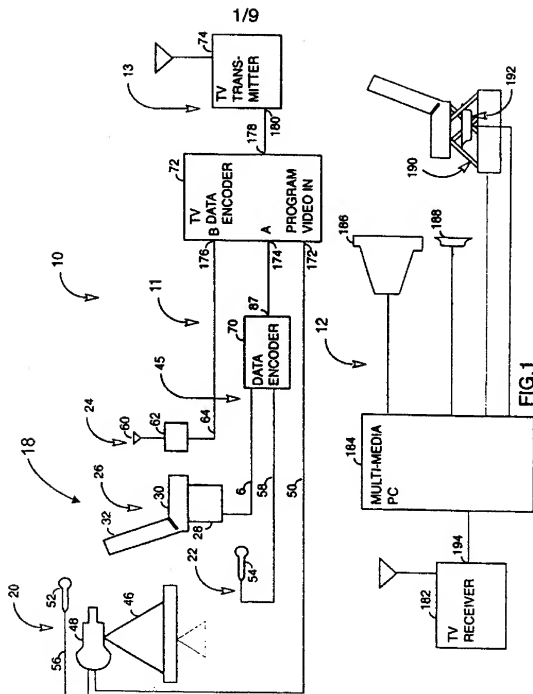
    b)   at said second location:

        i)   receiving said composite signal;

        ii)   decomposing said composite signal into said television signal and said environment signal;

        iii) producing images and sounds in response to said television signal; and

        iv) operating a transducer for controlling said property of said environment in response to said environment signal.

80.   An apparatus for simulating at a second location, at least one feature of an environment at a first location, the apparatus comprising:

    a)   a signal generator for generating signals representative of said environment at said first location, said signal generator including:

        i)   at least one measurement device for producing at least one environment signal indicative of a property of said environment;

        ii)   a television camera for producing at least one television signal in response to visual and audio stimuli as observed from said first location; and

        iii) an inserter for producing a composite signal including said environment signal and said television signal; and

    b)   an environment simulator at said second location, said environment simulator including:

    i)   a receiver for receiving said composite signal including said environment signal and said television signal representing said environment;

    ii)   a television data decoder for decomposing said composite signal into said television signal and said environment signal;

    iii) transducers for producing images and sounds in response to said television signal; and

    iv) a transducer for controlling at least one feature of said environment in response to said environment signal.

81.   An apparatus for simulating at a second location, at least one feature of an environment at a first location, the apparatus comprising:

    a)   means for generating signals representative of said environment, said means for generating signals including:

        i)   means for producing at least one environment signal indicative of a property of said environment;

        ii)   means for producing at least one television signal in response to visual and audio stimuli as observed from said first location; and

        iii) means for producing a composite signal including said environment signal and said television signal; and

b) an environment simulator at said second location, said environment simulator including:

    i) means for receiving said composite signal;

    ii) means for decomposing said composite signal into said television signal and said environment signal;

    iii) means for producing images and sounds in response to said television signal; and

    iv) means for operating a transducer for controlling said property of said environment in response to said environment signal.
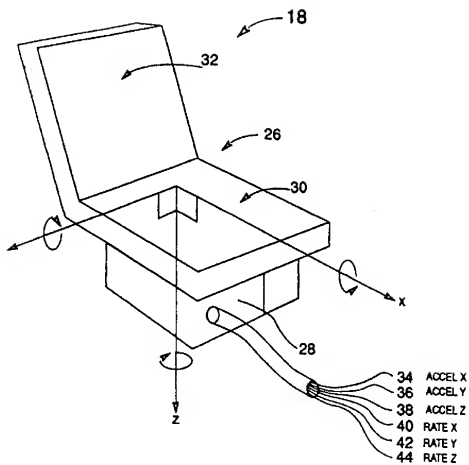
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FIG. 1
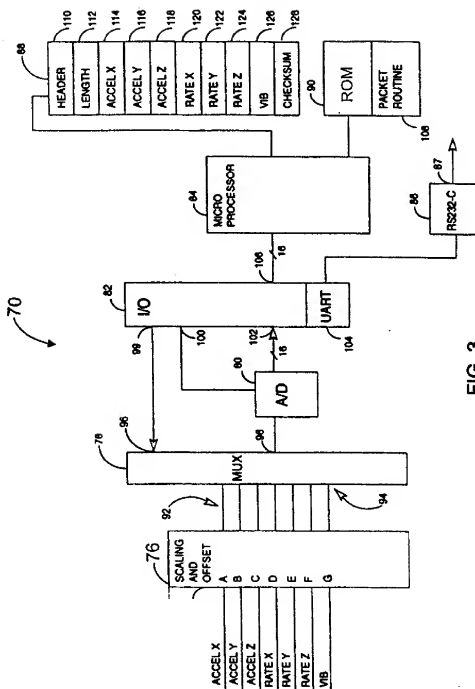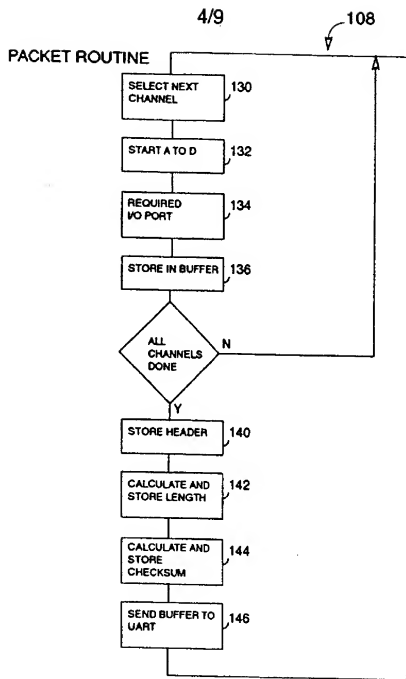
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FIG. 2

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FIG. 3

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PACKET ROUTINE

```
          ┌─────────────┐
          │ SELECT NEXT │ 130
          │ CHANNEL     │
          └─────────────┘
                │
          ┌─────────────┐
          │ START A TO D│ 132
          └─────────────┘
                │
          ┌─────────────┐
          │ REQUIRED    │ 134
          │ I/O PORT    │
          └─────────────┘
                │
          ┌─────────────┐
          │STORE IN BUFFER│ 136
          └─────────────┘
                │
             ◇ ALL
             CHANNELS  ─── N
             DONE
                │ Y
          ┌─────────────┐
          │STORE HEADER │ 140
          └─────────────┘
                │
          ┌─────────────┐
          │ CALCULATE AND│ 142
          │ STORE LENGTH │
          └─────────────┘
                │
          ┌─────────────┐
          │ CALCULATE AND│ 144
          │ STORE       │
          │ CHECKSUM    │
          └─────────────┘
                │
          ┌─────────────┐
          │SEND BUFFER TO│ 146
          │ UART        │
          └─────────────┘
```

FIG.4

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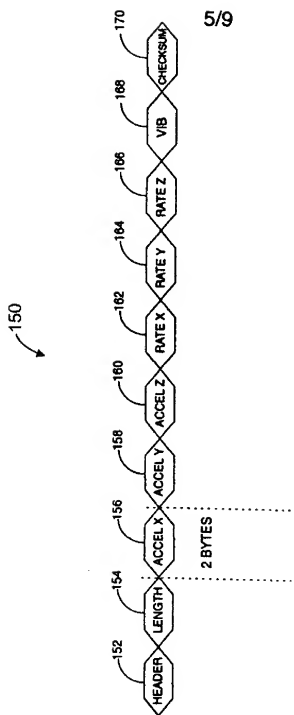

FIG. 5
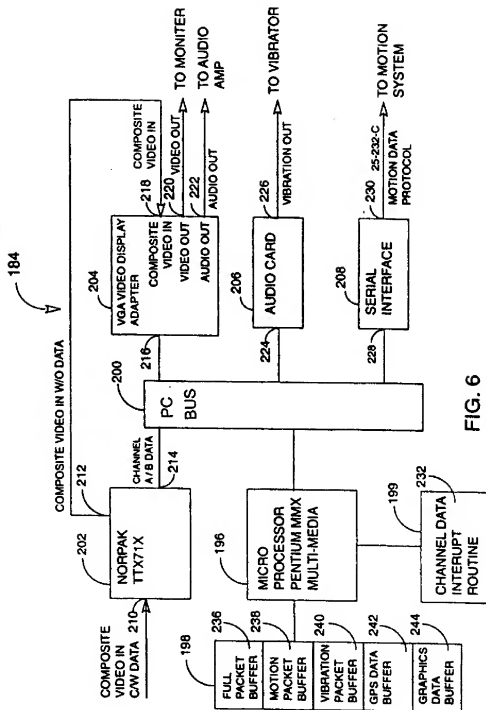
FIG. 6

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CHANNEL DATA INTERUPT
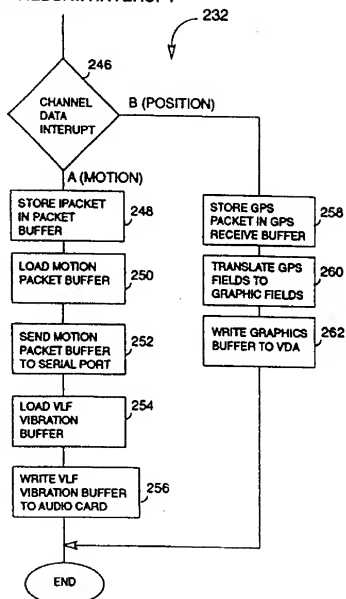
FIG. 7

FIG. 8

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FIG.9
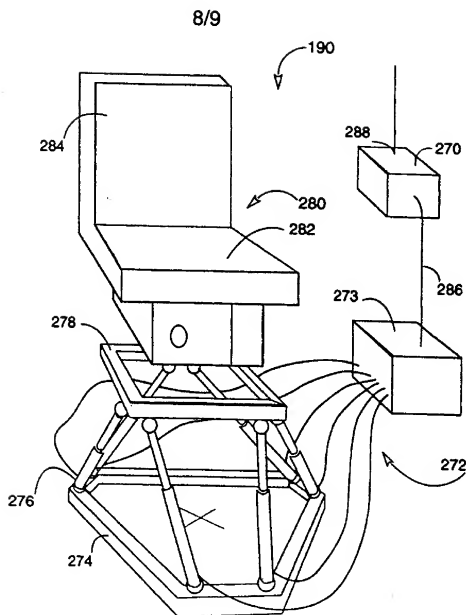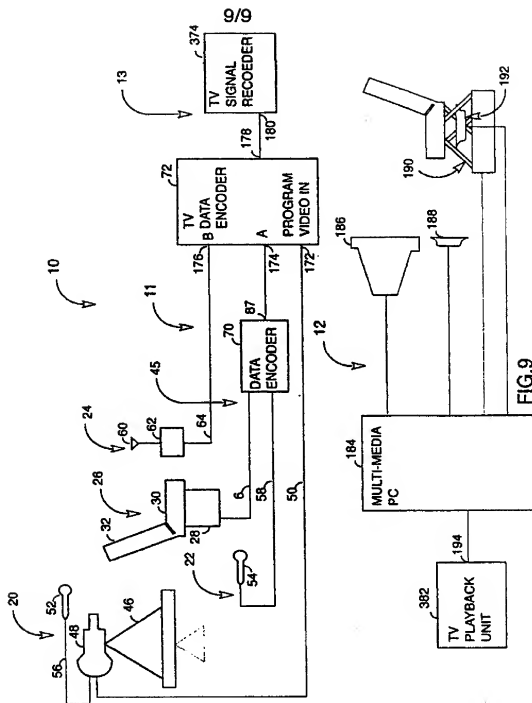
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6   H04N7/00   H04N7/088

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6   H04N   G09B   A63F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category°	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 814 896 A (HEITZMAN EDWARD F ET AL) 21 March 1989 (1989-03-21)	1-5,7, 9-12, 19-23, 25, 27-30, 37-41, 43,45-48
Y		17,18, 35,36, 53,54, 79-81
A	column 1, line 47 – line 51 column 3, line 54 – line 67 column 4, line 17 – line 36 ----	15,16, 33,34, 51,52

-/--

| X | Further documents are listed in the continuation of box C. | | X | Patent family members are listed in annex. |

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search	Date of mailing of the international search report
19 July 1999	26/07/1999

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 696 022 A (ACE DENKEN KK) 7 February 1996 (1996-02-07)	55-57, 60-65, 68-73, 76-78
Y		17,18, 35,36, 53,54, 79-81
A	column 7, line 13 - line 26 column 7, line 56 - column 8, line 30 column 13, line 1 - line 6 column 14, line 3 - line 37 -----	14,32,50

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Inter.   .nal Application No

PCT/CA 99/00411

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EP 0696022	A	07-02-1996	US	5707237 A	13-01-1998
			WO	9424652 A	27-10-1994
			JP	2625035 B	25-06-1997

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